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LODGEPOLE PINE STUDIES AT THE STRACHAN EXPERIMENTAL BLOCK IN ALBERTA

ONE WEEK LOAN

By
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Forest Research Division
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Lodgepole Pine Studies at the Strachan Experimental Block in Alberta

BY

D. I. CROSSLEY

INTRODUCTION

Harvesting of timber from the even-aged lodgepole pine stands (*Pinus contorta* Dougl. var. *latifolia* Engelm.) in Alberta is controlled by a flexible diameter limit, which results in the removal of only the largest and best trees. Such cutting regulations are, at present, realistic because they are geared to existing market conditions, but as these conditions improve with increasing industrial development the market will eventually absorb many of the diameter classes presently considered unmerchantable. With a broader market, cutting systems more suited to the silvics of the species can be employed. It is our objective to initiate a series of studies to determine suitable silvicultural practices for thinning, harvesting and regenerating lodgepole pine.

In 1951 the Alberta Department of Lands and Forests reserved for the use of the Federal Forestry Branch a 160-acre block of timber near Strachan, in the Rocky Mountain House district of Alberta. Experiments undertaken to date on this block include improvement, harvest, and conversion cuts, scarification and seed dissemination studies, phenological investigations, and complementary studies in entomology and pathology.

The area supports a typically dense, even-aged, 85-year-old lodgepole pine stand, averaging about six inches in diameter at breast height, with dominant heights between 65 and 70 feet. The stand is of a remarkably uniform character over most of the block, with the exception of the northeast corner which supports a two-aged overstory of pine mixed with aspen, and a white spruce understory. The site is a gently undulating plain of a shallow alluvial fabric over uniformly stratified outwash. Soil permeability is moderately rapid and the moisture regime is somewhat dry.

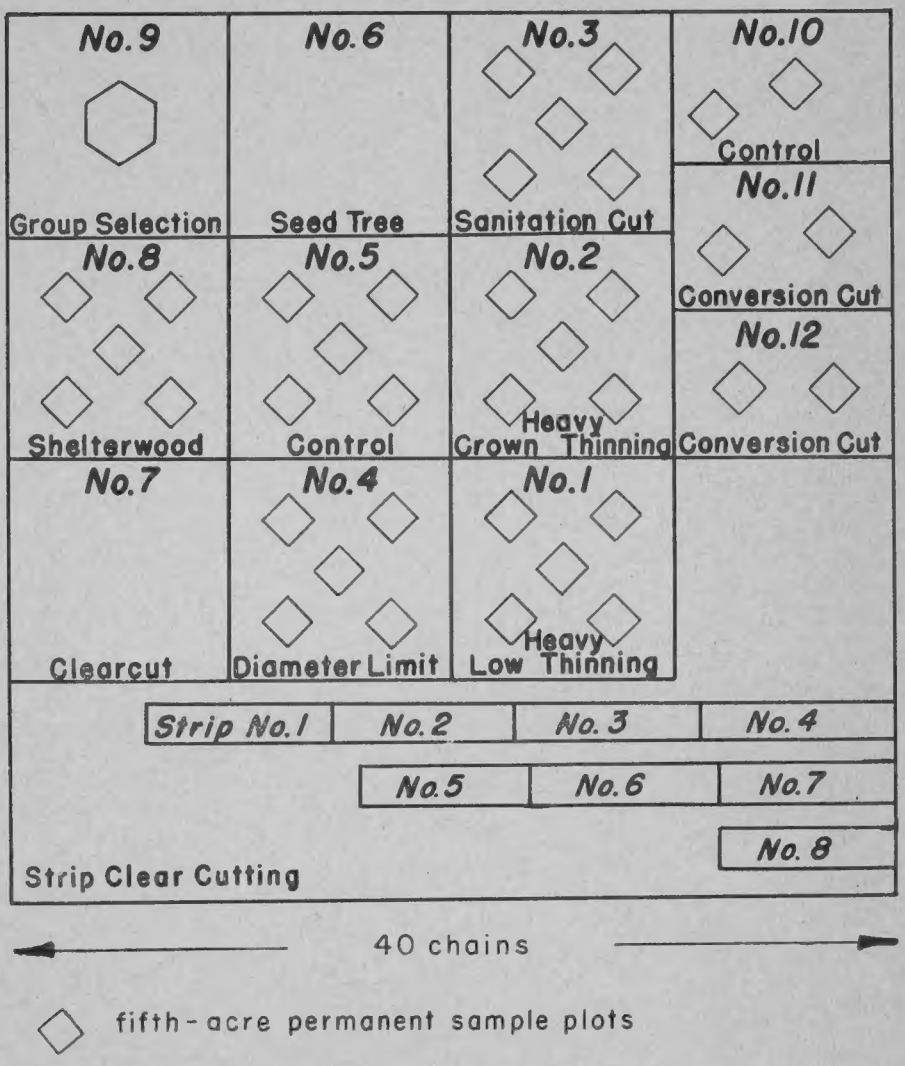
Preparatory work was undertaken during the summer of 1951, when 12 cutting compartments were laid out. Nine of these were 10 acres in size, and three were six acres. Each compartment was marked for cutting, and the logging was completed during the summer and winter months of 1951-52. Horse logging was adopted in order to reduce the damage to the residual stands. The release of seed from the cones was encouraged by lopping and scattering the slash.

The following year (1952-53) clear cutting in strips removed timber from the remaining portion of the block not primarily included in the compartment cuttings. This permitted the inclusion of regeneration studies following scarification of the clear cut forest floor.

The cutting and sampling pattern on the experimental block is presented in Figure 1 and includes three types of improvement cuts (compartments 1-3), six types of harvest cuts (compartments 4, 6-9, and strips 1-8), and two conversion cuts (compartments 11 and 12).

Figure I

Compartment and strip cutting on the Strachan Experimental Block



IMPROVEMENT CUTS

Compartment No. 1 — heavy low thinning
Compartment No. 2 — heavy crown thinning
Compartment No. 3 — sanitation cutting
Compartment No. 5 — control

In the first two improvement cuts listed, a well-spaced residual stand of approximately 300 trees per acre was sought. The sanitation cut involved the removal of all trees over a 3-inch diameter limit that were badly suppressed,

diseased, or deformed in a manner that would result in their eventual unmerchantability as poles or piling; this included trees exhibiting school-marms, spiral grain, sweep, and cat-faces. No consideration was given in this latter cut to final spacing or density.

TABLE 1—STAND STATISTICS PER ACRE

Compartment No.	Average diameter		Total number of trees		Thinning percentage	Total Basal Area		Thinning percentage	Total Vol. in cu. ft.		Thinning percentage
	b.t.*	a.t.*	b.t.	a.t.		b.t.	a.t.		b.t.	a.t.	
1	6·2″	7·1″	664	309	54	141	85	40	4,041	2,488	38
2	5·9″	6·4″	698	324	54	133	72	46	3,697	2,011	46
3	5·5″	6·0″	778	399	49	130	80	39	3,435	2,131	38
5	6·1″	.....	642	.....	.....	133	.....	.....	3,709	.....	.....

* b.t.—before thinning.
* a.t.—after thinning.

PLATE 1.—Compartment No. 1. Original stand.

PLATE 2.—Compartment No. 1. Residual stand after heavy low thinning.

PLATE 3.—Vertical view of unthinned crowns in control compartment.

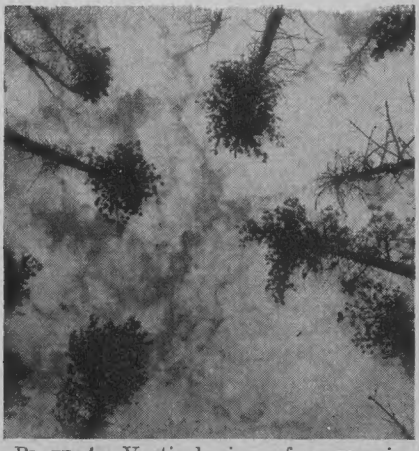
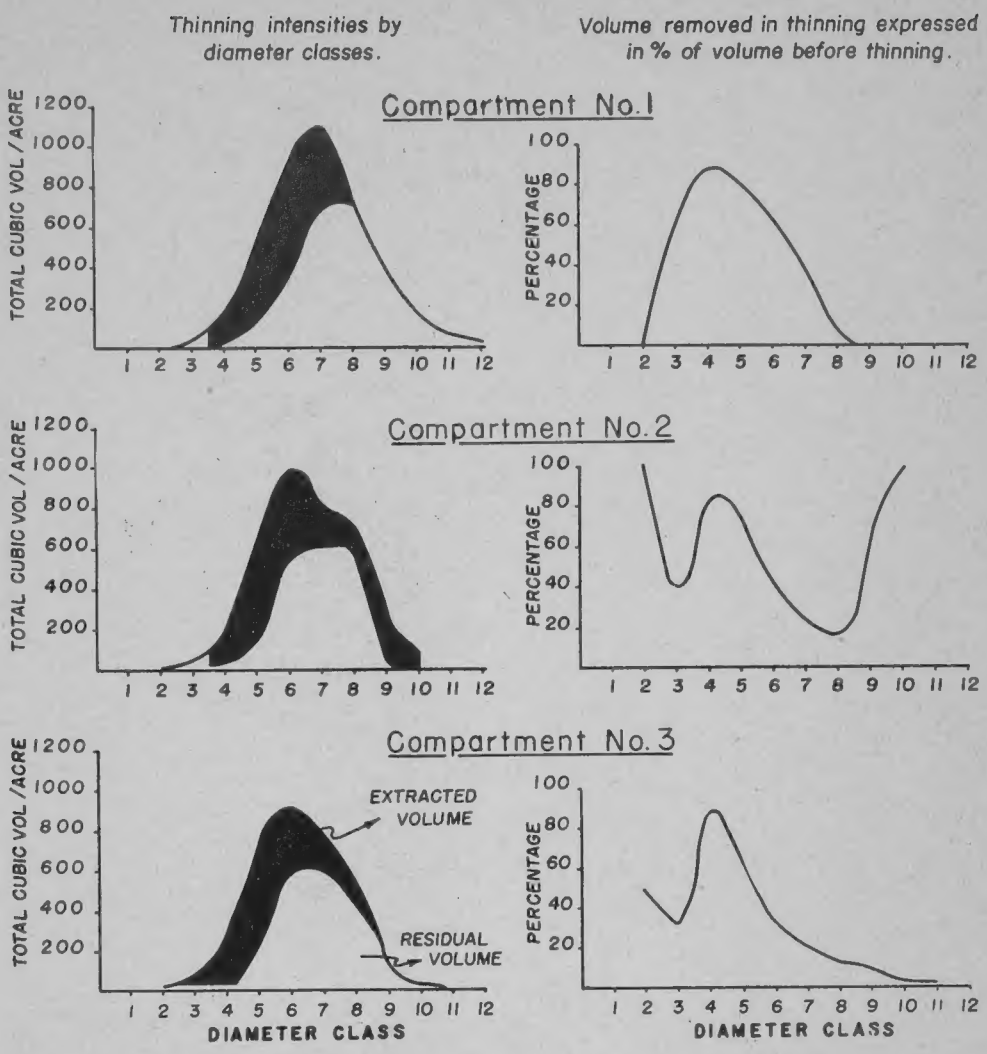


PLATE 4.—Vertical view of crowns in compartment No. 2 after thinning.

Figure 2



HARVEST CUTS

Compartment No. 4 — cutting to a 7-inch diameter limit.
Compartment No. 6 — clear cutting with scattered seed trees.
Compartment No. 7 — clear cutting with marginal seed source.
Compartment No. 8 — 2-cut shelterwood.
Compartment No. 9 — group selection.
Compartment No. 5 — control.

In the harvest cuts the 2-cut shelterwood involved leaving a residual stand of approximately 70 full-crowned dominants per acre, and the group selection removed one-quarter of the compartment volume in circular clear cut patches evenly distributed over the area, each patch being approximately one-twentieth of an acre.

TABLE 2—STAND STATISTICS PER ACRE

Compartment No.	Average diameter		Total number of trees		Cutting percentage	Total Basal Area		Cutting percentage	Total Vol. in cu. ft.		Cutting percentage
	b.c.*	a.c.*	b.c.	a.c.		b.c.	a.c.		b.c.	a.c.	
4	5·9″	5·1″	697	521	25	131	74	43	3,473	1,897	45
6	6·5″	9·0″	604	10	83	110	44	60	3,827	134	65
7	6·7″	.....	445	0	100	108	.....	100	3,019	.....	100
8	6·2″	8·4″	562	68	88	118	27	77	3,264	776	76
9	6·3″	6·8″	525	269	49	115	67	42	3,273	1,885	42
5	6·1″		642			133			3,709		

* b.c.—before cutting.
* a.c.—after cutting.

Figure 3

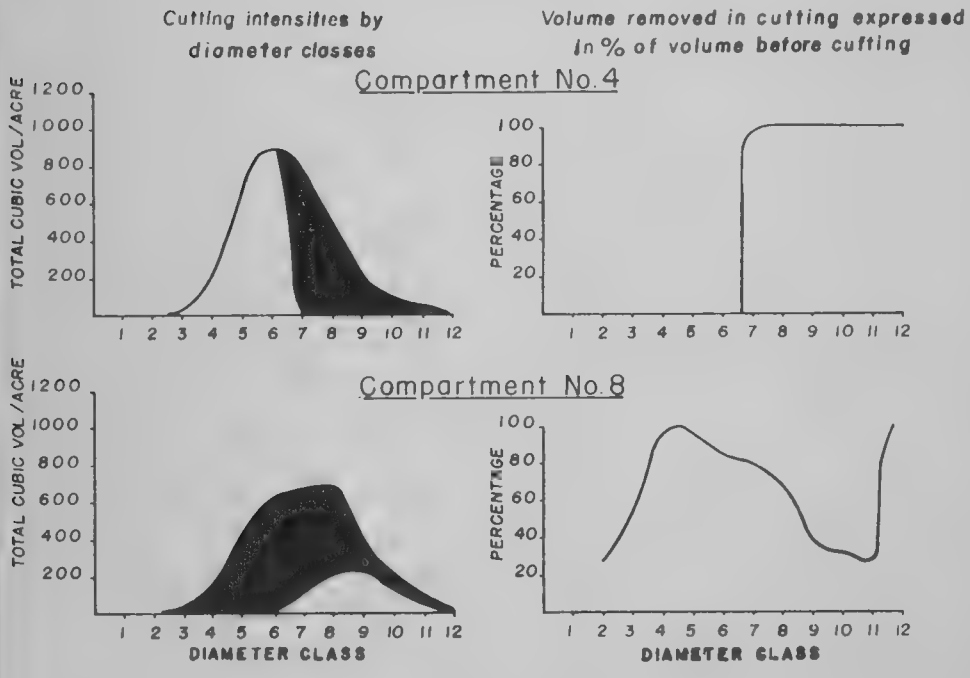


PLATE 5.—Compartment No. 6. Clear cut with scattered seed trees.

PLATE 6.—Compartment No. 7. Clear cut with marginal seed source.

PLATE 7.—Compartment No. 8. Residual shelterwood.

PLATE 8.—Compartment No. 4. Cut to a 7-inch diameter limit.

CONVERSION CUTS

Compartment No. 11 — removal of all merchantable pine.
Compartment No. 12 — removal of half of the merchantable pine.
Compartment No. 10 — control.

Future work in all three cutting studies will involve periodic collection of growth and mortality data from the permanent sample plots, as well as regeneration studies on the harvest and conversion cutting compartments.

Figure 4

Compartment No. 12

Stand distribution prior to conversion cut.

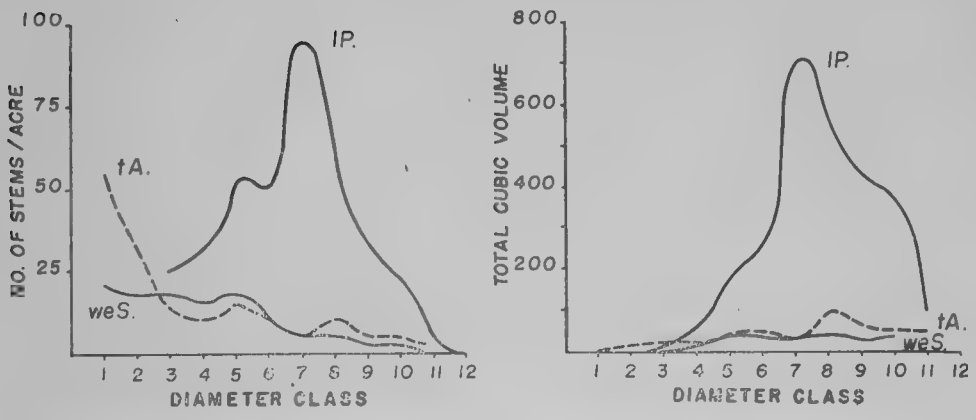


PLATE 9.—Conversion cutting area prior to removal of the merchantable pine.

PLATE 10.—Conversion cutting area after all merchantable pine removed.

SCARIFICATION

This project was designed to study the receptivity of the clear cut forest floor to lodgepole pine regeneration after mechanical scarification had bared the mineral soil. Seed source was either the marginal stand and cone-bearing slash, or the marginal stand alone.

Strips two chains in width, separated by chain-wide residual stands, were clear cut (Figure 1). Treatments are listed below; each was replicated and randomized.

Strips 1 and 6 — prescarified, slash lopped and scattered.
Strips 2 and 4 — unscarified, slash piled and burned.
Strips 3 and 7 — unscarified. slash lopped and scattered.
Strips 5 and 8 — prescarified, slash piled and burned.

Prescarification was completed during the summer of 1952 using a tractor-powered dozer blade, and logging was undertaken and completed the following winter.

PLATE 11. Prescarified forest floor.

PLATE 12.—Piling slash for burning after strip clearcutting.

In order to study regeneration, each clear cut strip is traversed by six lines of contiguous milacre list plots, representing a six per cent sample. Periodic tallies of regeneration, survival and growth are proposed.

LODGEPOLE PINE SEED DISSEMINATION

One of the major advantages in the management of lodgepole pine is the fact that most of the trees in stands of merchantable age bear a high proportion of serotinous cones. Under natural conditions, this storehouse of seed in the crowns serves to protect forest lands from denudation after fire, but fire, as a cultural tool, is usually too dangerous to be acceptable. This study was therefore initiated in an attempt to discover practical methods of obtaining the release of the seed from cone-bearing slash after logging.

In order to obtain seed release from a serotinous cone it is necessary to rupture the rosin bond which seals it. Once this is accomplished the cone scales gradually flex and seed is released. The most obvious, and only practical, source of heat to melt the rosin bond is that supplied by the sun, particularly that portion of the solar heat reflected by the soil surface. The highest temperatures are reached at the boundary between ground and air, decreasing upward and downward from this point. The study was therefore designed to ascertain the critical level above the ground's radiating surface beyond which cones would not open consistently.

Preliminary studies were of a fundamental nature. Using selected cones mounted at various levels above the ground, comparative cone tissue temperatures reached throughout the day were obtained. The instrumentation involved the use of fine-wire thermocouples embedded within the surface tissue and instant temperatures were read from a connected potentiometer.

From this study it was found that the temperatures required to rupture the rosin bond could be consistently obtained under certain conditions of direct radiation and cone height above ground.

The second phase involves the study of the relationship of these critical conditions to cones borne on logging slash. Degree of cone opening and amount of seed shed were the specific objectives of this phase of the investigation. The experimental block was well suited to this study of cone behaviour because of the variety of slash intensities and degrees of overhead shade that resulted from the harvest and improvement cuts.

Five milacre quadrats were established in each of the compartments, and in one of the strip cuts. Fresh cone-bearing slash was scattered over each quadrat, and 50 closed cones in varying positions throughout the slash were tagged for future detailed observation. Height above ground, exposure, and age of cone were considered to be the factors having the greatest influence on cone opening and these were recorded in detail. The first two factors vary as the slash settles and the needles drop off; this necessitated the continuation of the study until such changes became negligible.

PHENOLOGICAL STUDY

In order to obtain fundamental knowledge of the seasonal diameter growth pattern of lodgepole pine, investigations were undertaken involving the daily measurement of radial increment. These sensitive readings required the use of a dial gauge dendrometer, and were collected throughout the growing season from three groups of ten dominant trees in undisturbed stands. This investigation continued for two seasons in an attempt to establish a pattern of growth.

PLATE 13.—Dendrometer positioned on bole for radial increment reading.

COMPLEMENTARY STUDIES

Varying degrees of residual stand and amounts of slash left after logging present certain hazards which may defeat the purely silvicultural aspects of any individual thinning, harvest cutting, or conversion cutting system. With this in mind the Forest Biology Division of the Department of Agriculture has undertaken complementary studies on the Strachan experimental block.

Entomological Studies

Immediately after logging the Laboratory of Forest Zoology commenced investigations designed to establish some form of bark-beetle hazard rating. The varying amounts of slash on the forest floor suggested an excellent opportunity to study some of the factors underlying the variability in concentration of certain bark-beetles and their effect upon the various intensities of residual stand.

In the spring of 1952 the untouched stand (control compartment No. 5) was cruised, and data obtained on the endemic bark-beetle population on cut-over compartments. Sampling of the slash and stumps during the following seasons established the bark-beetle population available for attack on standing trees. A final cruise estimated the total infested trees in the residual stand on each

compartment one season after the populations had built up to a maximum in the logging debris. An integral part of such a study is the gathering of fundamental information on the effect of environment, and of parasites and predators on bark-beetle populations.

Pathological Studies

Because the success of silvicultural cutting methods cannot be divorced from the possibility of disease which may be encouraged by the environmental changes, the Forest Pathology Laboratory has designed and initiated a long-term project on the Strachan experimental block to assess the rate of slash deterioration.

Assuming that rapid slash decomposition is an objective of good forest management, the study is attempting to relate it to cutting method. Identification, ecological succession, and the significance of fungi associated with wood deterioration all form a part of the investigation, as well as the significance of moisture, temperature, pH and other factors. The relationship between the rate of slash decay and fire danger is another obvious objective. In addition the possibility of hastening decay by artificially inoculating with minced cultures of wood-destroying fungi, and spraying slash with nutrient is being investigated.

The Strachan experimental block is the first of its kind in the Province of Alberta. The improvement, harvest, and conversion cuts are comparatively large-scale tests, long-term in nature, and intended to amplify basic studies previously conducted elsewhere on a smaller scale and under more rigid control. Loss of experimental control due to inability to replicate treatments is the price to be paid for many large-scale tests. Some results will be clear cut and definitive, others will require interpretation. Much can be gained from the satellite experiments under way, and without doubt, interim results from some experiments will materialize as the studies progress. In order to test the general validity of the findings that develop from this first large-scale test, similar comparative projects are contemplated in representative lodgepole pine stands within the Province of Alberta.

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